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A BIOLOGICAL EVALUATION OF THE ROSEBUD PROGENY TEST SITE, SIX RIVERS NATIONAL FOREST

PSW FOREST AND RANGE EXPERIMENT STATION
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ABSTRACT

Seven dead Douglas-fir trees planted in 1980 on the Rosebud Progeny Test site were examined. The major cause of mortality appeared to be self-girdling which predisposed the saplings to insects and Armillaria mellea. Black stain root disease was found on one sapling and was active in the adjacent stand. Management alternatives, including 1) no action, 2) remove dead and chlorotic trees, 3) remove trees adjacent to black stain-infected trees, and 4) abandon the test site, are discussed.

INTRODUCTION

At the request of personnel in the Regional Tree Improvement Program, we examined the Rosebud Progeny Test site on the Orleans Ranger District, Six Rivers National Forest, on October 24, 1984. The objectives of the evaluation were to confirm the suspected presence of black stain root disease, to determine the presence of or potential for other insect and disease problems which could affect the objectives of the Regional Tree Improvement Program, and to provide alternatives to reduce and prevent unacceptable pest-related damage.

OBSERVATIONS

The Rosebud Progeny Test site, located in the Rosalena area off of Road 13N18 on the Orleans Ranger District, is within a second-growth stand of Douglas-fir which also contains tanoak and minor amounts of black oak and ponderosa pine. The test site was cleared, stumps removed, and disced in two directions. Douglas-fir seedlings were planted in the spring of 1980. The planted

Douglas-firs have grown vigorously and range in height from 5 to 10 feet, with an average diameter of about 1.8 inches. No insect or disease problems were noted during a previous evaluation (reference 3430 Evaluation, Report No. 81-24, August 28, 1981).

During this 1984 evaluation we observed seven dead Douglas-firs that died last year or early this spring, and an equal number of trees with chlorotic, shortened needles and little or no current-year growth. Except for two dead trees and one fading tree in Set 1, Block 6, the dead and chlorotic trees occurred randomly throughout the site, with no evidence of grouping or clumping of affected trees.

The most significant pest problem noted was black stain root disease, caused by Ceratocystis wagneri. Black stain root disease was confirmed in one (tree just east of trees #628 and #234, Block 4, Set 2) of the seven dead Douglas-firs examined within the test site. Numerous Douglas-firs in the stand immediately adjacent to the test site had thin and fading crowns typical of a root disease. Black stain root disease was confirmed (brown to black stain in sapwood at the root collar and in the main stem) in three recently dead pole-sized Douglas-firs adjacent to the road leading to the site. Other pole-sized Douglas-firs along the road had thin and fading crowns.

Seven dead trees and one living tree with chlorotic foliage were excavated and root systems as well as above ground stems and foliage examined in the field. Root systems and root collars were transported to San Francisco and examined in the laboratory. Observations on the eight trees are summarized in the Appendix. Black stain root disease was found in one dead tree. Mycelial fans and decayed wood typical of Armillaria mellea was found in the root collars of six of the seven dead trees. Flatheaded borers (Buprestidae), roundheaded borers (Cerambycidae), and ambrosia beetles (Xyleborus spp.) were common in stem and root collars of the dead trees. Galleries of a Hylastes sp. were present in roots of one tree.

The most consistent observation on all trees examined was the physical self-girdling by the larger roots of themselves and their root crowns. Tap root and lateral root development into the surrounding soil was limited. The seedlings were orginally grown in tubes and, in most instances, the roots which developed in the tubes had turned upward, were wrapped around each other, were confined mostly to the limits of the original tube, and were now girdling each other and the root collar. This girdling resulted in flattening of roots, callusing, and wounding of bark tissues.

Two dead trees planted in 1983 (?) in Block 4, Set A, Rep A were examined in the field only. No insects or disease problems were evident, but both trees were self-girdled at the root collar.

These observations suggest a typical series of events associated with tree death at Rosebud. Root contriction in the original tubes binds roots together, turns them upward, and limits development into the surrounding soil when planted. Growth of these roots around themselves and the root collar after planting results in girdling, wounding of bark tissues, and tree stress. The stressed trees are attacked at the root collar by A. mellea surviving on root

pieces buried in the soil, and, in one instance, the stressed tree was probably attractive to root-feeding beetles which vectored C. wagneri into the tree. The borers and beetles associated with the stressed trees are typical, secondary invaders of dead and dying tissues.

Two additional, relatively minor, situations on planted Douglas-firs within the test site were observed. Two trees had a stem canker, typical of Dermea psuedotsugae. Some of the new growth on trees scattered throughout the site was flacid and dead, probably from spring frost damage.

MANAGEMENT ALTERNATIVES

Nothing can be done now to prevent continued self-girdling of the trees already planted, but reasons for this effect should be investigated and methods for reducing it in the future should be developed and implemented. Freeing and spreading out the root system before placing the seedling in the ground may be beneficial. Growing bare-root stock, or growing the seedlings for a shorter period of time in the tubes, are other possibilities. Alternatives are available to reduce the possible impact of black stain root disease at the site.

1. No action. Because the trees were all grown in tubes and planted the same way, it is probably safe to assume that additional trees will die as tree growth continues and girdling of the root crowns occur. These stressed trees will be favorable for development of Armillaria root disease and will be attractive to root-feeding beetles. Because black stain root disease is prevalent in the adjacent stand, beetles from those infected trees may vector the disease into the stressed trees on the test site. Tree-to-tree spread of the disease can occur via root contacts or by growth of the fungus through the soil for short distances and direct infection of small feeder roots. As the root systems of the planted trees spread, chances for root grafting, local spread of the disease, and development of a gradually enlarging root disease center increases. The initiation and enlargement of black stain root disease centers within the test site may reduce the number of replicated trees in planted families to the point where limited useful information can be obtained for the Tree Improvement Program.

Armillaria mellea will probably remain confined to an individually-infected tree and will not spread to adjacent Douglas-firs to create an enlarging center like the black stain fungus. Also, the beetles and borers now associated with the affected trees at Rosebud attack only weakened, dying and recently dead young Douglas-fir, and would not build up and spread to adjacent healthy trees.

2. Remove dead and chlorotic trees. Removing dead trees, including as much of the root system as possible, will reduce the risk of local spread of black stain. Although the fungus will remain in infected root pieces left behind in the soil, current research information suggests that the pathogen will not survive in dead tissues or in the soil for more than a year or so.

Trees with foliar symptoms, such as chlorotic and shortened needles and little or no current year growth, should also be considered for removal. Regardless of the cause of the symptoms, these trees are being affected by factors that negate the objectives of the test site. If these chlorotic trees are infected with black stain, removing them early would reduce the risk of local spread through root systems.

3. Remove trees adjacent to black stain-infected trees. Black stain can spread to adjacent trees. In early stages of infection, these adjacent trees will not exhibit above ground symptoms. Removing a margin of trees from around a tree known to be infected would reduce the risk of future local spread. This removal of adjacent trees would become more important as the trees on the test site increase in size and the chance for root contact among trees increases. The effect of removing these trees on the objectives of the Tree Improvement Program would have to be weighed against the reduced risk of disease centers developing and enlarging.

As with alternative 1, alternatives 2 and 3 will not prevent additional losses from self-girdling. However, alternatives 2 and 3 will discourage the future local spread of black stain root disease.

4. Abandon the test site. Black stain root disease has the potential to adversely affect a sufficient number of trees on the site that maintaining the site to compare characteristics of different planted families would not be useful. However, current levels of infection suggest that abandoning the site because of the pathogen need not be considered in the near future.

The Rosebud Progeny test site should be monitored for development and spread of the disease by implementing a surveillance program. A knowledge of the future incidence of the disease on the site would help the Tree Improvement Program decide whether alternative 2 or 3 is more efficacious, or if alternative 4 needs to be considered.

APPENDIX

Summary of observations on trees examined on the Rosebud Progeny Test Site.

Tree Location	Observations		
	Physical Damage	Disease	Insect
B6, Set 1 Tree #207	girdling of root crown from wrapped-around root system	decayed wood and resin-soaking at root collar associated with Armillaria	flatheads in stem and root crown
B6, Set 1, 2 rows downhill from #207	girdling of root collar and flattening of roots from physical force of growing together	decayed wood and heavy resin-soaking at root collar associated with Armillaria	Flatheads in stem, crown and larger roots; Hylastes gallery in roots
B6, Set 1, living tree between 1 and 2 above	self-girdling of root collar; poor root development from original tube (no tap root, only two laterals)	none	none
B6, Set 1, Tree #6990	self-girdling of root collar and associated callusing; planted on 8-10 inch diameter piece of DF root with Armillaria rhizomorphs	decay and resin-soaking at root collar associated with Armillaria	none
B1, Set 2, ?	self-girdling of root collar and larger roots, no lateral root development into soil	decay and resin-soaking at root collar associated with Armillaria	flatheads, round-heads, and ambrosia beetles in stem and root collar
B4, Set 2, Tree #1423	swollen, callused, and girdled root collar from bound root system; planted on large piece of old DF root	none (no resin-soaking)	flatheads in main stem

B4, Set 2 (?), tree east of #628	self-girdling of root collar; planted on and adjacent to chunks of DF roots with Armillaria	black stain in two lateral roots and 6" up into main stem; Armillaria in roots and at root collar associated with resin-soaking and decay	flatheads in main stem; no insects seen in below ground root system
B7, Set 2, Tree #0251	self-girdling of root collar from bound root system; soil saturated with water	decay and resin-soaking at root collar associated with Armillaria	flatheads in main stem